MANUAL

User Manual for Sunways
Solar Inverters NT 2600, NT 4000 and
NT 6000

180 mm

300 mm

510 mm

List of Contents

EN

4.0 Appendix

EN

1.0   General information

The User Manual contains safety hints. These are identified by a triangle with an exclamation mark.

General safety information

All safety hints contained in this section and throughout the User Manual must be complied with at all times to guarantee the user's safety. The described product must not be operated if any mechanical or electrical components are defective.

Before commissioning the system, we strongly advise you to carefully read and heed the instructions! Non-compliance can have serious consequences, for example damage to the unit or other property or physical injuries with possible loss of life.

The solar inverter must be installed by a trained, qualified electrician. The electrician must be approved by the competent electricity board (EB).

The relevant tasks to be carried out are identified by an additional adjacent symbol in the respective chapter headings.

EN

Opening the unit

Before opening the cabinet, the unit must always be disconnected from the grid and from the PV generator.
The unit continues to conduct a hazardous voltage internally and at the connection sockets for ca. five minutes after disconnecting from the PV generator. The energy storage capacitors are only fully discharged after this period.
After disconnecting the unit from the grid and from the PV generator, you must wait at least five minutes before opening the unit.

Scope of supply

· Sunways Solar Inverter in the NT series
· Installation frame
· Manual, setup, warranty card, CD-Rom with software
· 2 pairs of TYCO SOLARLOK connectors

Inspecting the delivery

The condition of our products is checked prior to delivery. Although our products are carefully packed in recyclable packing, transportation damages can still occur. These are generally the transport company's responsibility.

Please inspect the delivered solar inverter thoroughly!

If you discover any damage to the packing or the solar inverter, please inform the transport company immediately. Your specialist dealer will be glad to assist you if required. Any damages must always be reported to the transport company in writing seven days after receipt of the goods at the latest.

EN

Integration of the solar inverter into the PV system

Design of the PV generator

The technical data of the selected PV generator must be within the specification of the solar inverter (see Technical Data). The Sunways NT Sundim design program for the PV generator may be helpful. Sunways NT Sundim is available on the enclosed CD or from our website, www.sunways.de.

Please take account of the following points before planning your system:

· Pay attention to the skyward alignment of the modules. You will obtain maximum yield in Central Europe with a module inclination of 30° to the horizontal and a direct southerly alignment of the generator field.

· The output of the cells decreases as the module temperature increases. Install your PV generator with adequate rear ventilation.

· Check your PV generator for soiling ca. every three years. This occurs particularly at the lower edge of the modules and forms a film, which even heavy rain cannot wash away. Decreases in yield can be prevented by cleaning with a wet cloth or a brush.

· Avoid shading of individual modules or solar cells in your system. This can result in heavy losses in yield.

Standard components of a PV system

Depending on the recommendations of
your electrician, your PV system will con-
sist of the following components:
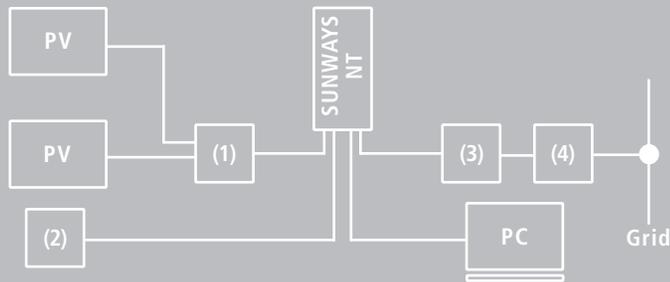
(1) **PV generator switch**
(2) **Irradiation sensor with
    integrated temperature
    sensor**
(3) **Mains fuse**
(4) **Energy meter**

PV generator switch:
Designed as DC load break cut-out to cut
off the PV generator from the solar inverter.
Dimensioning: min. 800 V, ≥ 16 A

Grid connection:
3-phase (Feed-in: 1-phase; grid monitoring:
3-phase)

Protection concept

The following parameters are monitored continuously and in parallel by the micro-controller and displayed on the screen:

· AFI error (ground fault)
· Overheating of the cooling element
· DC overvoltage
· AC undervoltage/overvoltage

In the event of a fault, the conversion is immediately blocked and the grid relay disconnected.
In addition, the following protective devices are provided on both grid and PV generator side:

· Grid-side varistors
Protect the power semiconductors from high-energy, time-limited voltage spikes on the grid and provide for a reduction of energy in the throttle in the event of grid disconnection.

· Generator-side varistors
Thermally monitored varistors provide protection against atmospheric overvoltages (e.g. due to remote strikes during storms).

2.0   Information on installation

Electrical safety

Before opening the cabinet, the solar inverter must be disconnected from the grid and from the PV generator.

The solar inverter continues to conduct a hazardous voltage internally and at the connection sockets for the PV generator for ca. five minutes after disconnecting from the PV generator. The energy storage capacitors are only fully discharged after this period.

After disconnecting the solar inverter from the grid and PV generator, you must wait at least five minutes before opening the solar inverter.

Mechanical safety

During installation, make sure that the cables or connection lines fitted to the solar inverter are securely laid and that suitable mechanical cable supports (cable ducts etc.) are used.

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Information on cleaning

Before cleaning, disconnect the system from the power grid by opening the grid breaker (main fuse) and open the DC switch on the PV generator, in order to exclude the danger of electric shocks.

Use a soft, dry cloth to clean the system. Never use corrosive, solvent-containing or abrasive cleaners or polishes.

The solar inverter must be installed by a trained, qualified electrician. A special tool is necessary for installation. Please read this chapter very carefully.
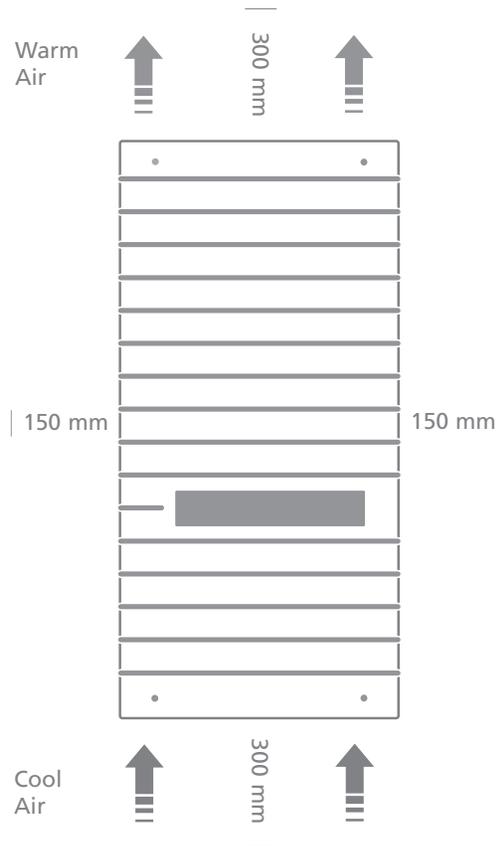
Requirements on the place of installation

· Mechanical bearing capacity
During installation please bear in mind that the solar inverter weighs 26 kg. The installation base must be firm and capable of continuously bearing the weight.

· Thermal interaction
The installation base must consist of flame-retardant material (e.g. no wood or plastic in the base; concrete and brickwork are suitable), as the heat sink emits temperatures up to max. 85°C.

A minimum distance of 300 mm must be maintained above and below the cabinet, and 150 mm on right and left from other units, cabinets, ceilings, cable ducts etc..

The solar inverter must be installed vertically, so as not to hinder adequate free convection.

Several solar inverters must not be installed on top of each other, so as to prevent reciprocal heating.

If installing the solar inverter in a switch box, ensure adequate heat dissipation.

The ambient temperature must not fall below or exceed –25°C or +40°C.

The solar inverter should not be exposed to direct solar irradiation, so as to protect it from unnecessary external heating.

· Protection from damp and foreign bodies
The IP54 high protection class permits installation both inside and in roofed outdoor areas, but the solar inverter must not be exposed to direct rain.

Make sure that the solar inverter cannot be exposed to foreign bodies (deposits of dust and dirt).

Electrical connection and cable entry

For installation, please observe the instructions in the "Setup" leaflet!

If the solar inverter is fixed to the installation frame, the electrical connection can be led through. The unit may only be opened by a qualified electrician. The cabinet cover must first be released and removed.

The following cable inlets are located on the underside:

RS 232, RS 485,
Irradiation sensor with integrated temperature sensor cable

AC wiring loom
L1, L2, L3, N, PE

– DC   – DC   + DC   + DC

$C \, \epsilon$

Sunways AG

Solar Inverter
Type NT6000
Serial Number
SI60–D06-0445-0089

Solar 350...750 V=
15 A max.

Grid 3 AC 400V~
22 A, 5 kW
50 Hz

RCD inside
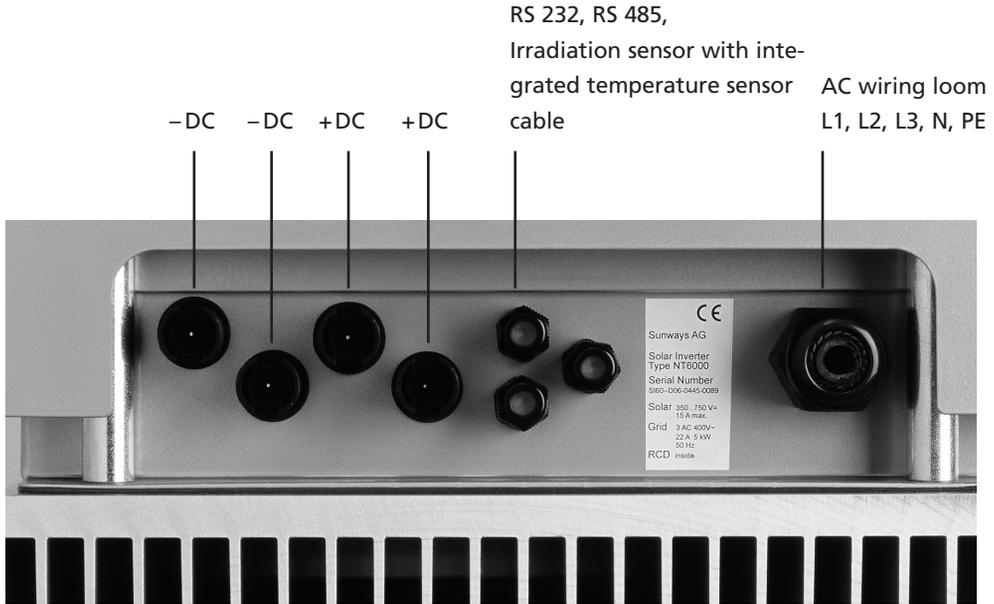
Fig.: Inlets on the unit underside

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Grid connection

The grid connection of the solar inverter must have 5 wires (L1, L2, L3, PE, N). Cable cross-sections of 5 x 4 mm2 are recommended.

The solar inverter is connected to the supply grid via the circuit board terminals inside the unit.

As line safety element in the grid feed-in direction, we recommend a 3 x 25 A automatic cut-out. No consumption units must be connected to the feed line from the solar inverter to the automatic cut-out. The solar inverter only feeds in via terminal L1.

If several solar inverters are operated in parallel, the feed-in phase L1 of the unit must be evenly distributed over grid phases L1, L2 and L3 (see figure below).

Three-phase grid connection distributed over three units
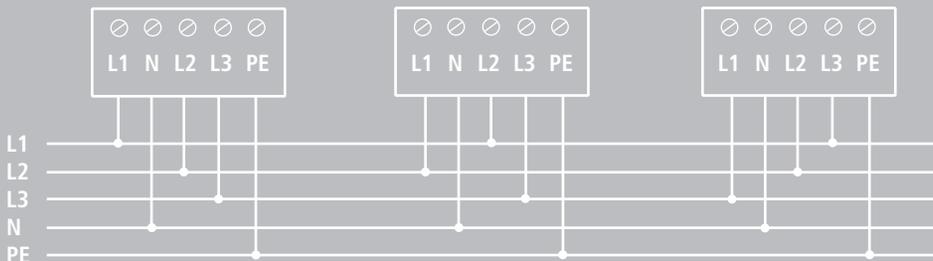
You must use adequately dimensioned cable cross-sections in order to avoid a considerable increase in the grid impedance between the domestic distribution and the solar inverter. The terminal range of the AC terminals is 0.5 to 6 mm2 for rigid cables and 0.5 to 10 mm2 for flexible cables. With a high grid impedance, i.e. with a long line or too small a cross-section, the voltage increases at the grid terminal during feed-in.

If the terminal voltage exceeds the permissible value, the solar inverter is disconnected from the grid.

Carefully perform the following steps:

· **Check that there is no voltage before introducing the supply main into the unit.**

· Lead the 5-core AC cable (outer diameter 9 – 17 mm) through the M25 threaded cable gland.

· Connect cables L1, L2, L3, PE and N to the relevant circuit board terminal with the help of a slot-head screwdriver (see figure below).
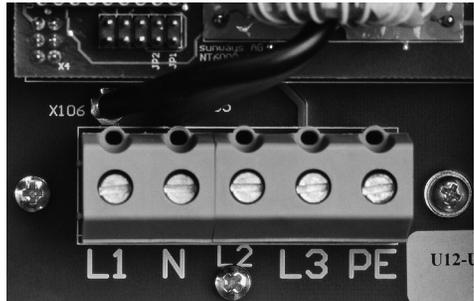
· Tighten the M25 screw connection, so that the cable cannot exert any mechanical force on the circuit board terminal.

PV generator connection

· Preparation

Execute the DC cabling according to your electrician's system dimensioning. Check each PV string for correct functioning by performing a no-load voltage current and short-circuit current measurement.

To achieve the necessary protection against hazardous contact voltage during the installation of PV systems, the positive and negative conductors must be kept separate from the ground potential (PE).

Contactable, conductive parts of the PV generator (e.g. metal frame, supporting structure etc.) must be earthed (connected to PE).

Check that the generator is free from ground faults.

Make the electrical connection to the solar inverter.

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· Connection

The PV generator is connected via the externally accessible, shock-proof TYCO SOLARLOK connectors, which are enclosed with the delivery. The TYCO SOLARLOK connectors are designed for a cable cross-section of 4 mm2 and must be crimped (see data sheet and connector assembly with TYCO crimping tool on page 144).

Connect the two right DC female connectors with «+», the two left DC female connectors with «-» of the PV generator (see figure below).
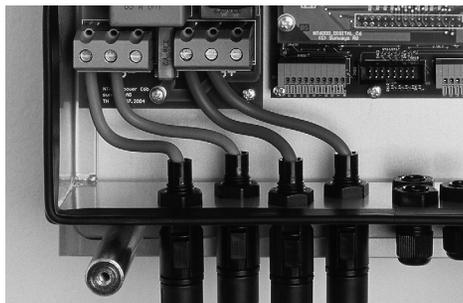
Important information

· The direct PV generator voltage is available internally after connecting the PV generator to the solar inverter via the DC connectors and switching on the PV generator switch!

· Please note that the input capacitors are still charged even after switching off the PV generator switch or removing the PV generator plug connection!

· After disconnecting the AC and DC side, the solar inverter still conducts voltage for up to ca. five minutes!

· Therefore, wait for at least five minutes until the internal voltage has dissipated. Then you can work on the terminals! Please note the general safety information on pages 83 and 84!

· The DC voltage can be up to 750 V. The unit may only be opened by a qualified electrician!

· Always disconnect the PV generator side first by opening the PV generator switch, and then the grid connection by isolating the relevant mains fuse!

· If you do not have a PV generator switch in your PV system, you must disconnect the grid connection first of all by isolating the relevant mains fuse. However, a «grid error» will be entered in the error memory of the solar inverter!

· Disconnection of the PV generator by removing the TYCO SOLARLOK DC connectors must never be performed under load. In the event of non-compliance, the connectors could be damaged by a strong electric arc. In this case, the relevant connectors must be replaced!

Communication connections

Via the communication connections (interfaces), operating data can be retrieved from the data memory with an external computer and specific operating settings made. Two interfaces are available: RS 232 and RS 485.

The standard communication interface is the RS 232 interface, which is installed in all current PCs and notebooks. This interface allows you to establish contact with your PC immediately, using a connecting cable. The use of more than one solar inverter or cable lengths of more than 50 m requires the use of the RS 485 interface.

The connections for the RS 232 or RS 485 interface supply cable are also made via circuit board terminals and via the M12 screwed cable glands in the cabinet.

A 3-core cable is used for signal transmission via the RS 232, and a 2-core cable for the RS 485 interface
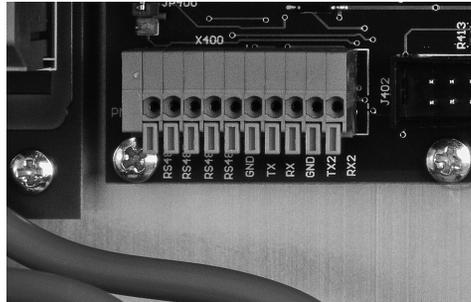
(Top figure) RS 232 and RS 485 interfaces with the signals (from left to right): RS 485+, RS 485+, RS 485-, RS 485-, GND_G, TX, RX, GND_G, TX 2, RX 2.

Attention: RS 485+ and RS 485- are duplicated. This means that the cable entry and exit are additionally clamped.

· **Connection**

Remove the cover of the solar inverter before connecting an interface cable. Pay heed to all safety hints (Pages 90 and 91).

You will find the necessary cable terminal block with the RS 485+, RS 485-, GND_G, TX, RX, GND_G, TX 2, RX 2 connections on the board in the centre, bottom left (see figure on the left). Note the following terminal configuration:

RS 232:   GND, RX, TX
RS 485:   RS 485+, RS 485-

(The remaining signals, TX2 and RX2, are only for service purposes.)

Use a small screwdriver. Press the orange terminal. The terminal will open.

Insert the cable stripped to a minimum of 11 mm into the respective terminal hole.

Release the screwdriver. The cable is fixed in the connection.

Once again, check that the cable connection is firmly located.

Seal the unrequired cable glands by placing a spare piece of cable in the gland hole and tightening with the screw clamp.

Please heed the description on the Sunways NT Monitor software in Chapter 3.2.

Connecting the sensors

· Optional irradiation sensor

The optional addition of an irradiation sensor (type Si-01TC-T from Ing.-Büro Mencke & Tegtmeyer) with integrated PT-100 temperature sensor for temperature measurement enables recording of the irradiation data and the corresponding module temperature in the cycle of the internal data memory.

This additional measuring unit helps with analysis of the system. On the basis of the values, possible errors in the PV generator, such as e.g. shading or failure of solar cells, can be detected.

For demonstration purposes, the irradiation sensor and the corresponding data can be used to show how a PV system functions. In conjunction with the Sunways NT Monitor visualisation software, the stored data can be displayed.

Before you connect an irradiation sensor, you must remove the cover of the solar inverter. Pay heed to all safety hints on pages 90 and 91. Please note that the inputs and outputs are not short-circuit resistant.

The optional irradiation sensor with temperature sensor is connected to the corresponding terminals at the bottom right of the middle board.
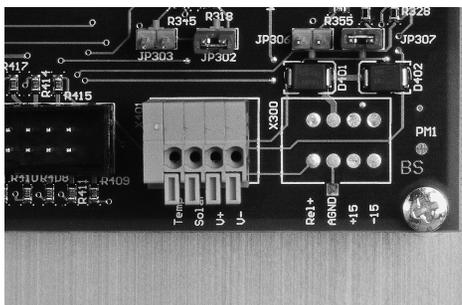
(Top figure) Connection block for temperature sensor cables with the signals: Temp, Solar, V+ and V-.

Configuration of the cable terminal block:

Temperature sensor
measuring signal: Temp
Solar radiation
measuring signal: Solar
Positive supply, 5V: V+
Supply, GND: V-

Using a small screwdriver, press the orange
terminal. The terminal will open.

Insert the cable stripped to a minimum of
11 mm into the respective terminal hole.

Loosen the screwdriver. The cable is fixed
in the connection.

Once again, check that the cable connec-
tion is firmly located.

Seal the unrequired cable glands by
placing a spare piece of cable in the gland
hole and tightening the screw clamp.

Connect the solar inverter internally via the ground cable (yellow-green) to the cabinet cover. (See also Setup, step 7)

Put the cabinet cover on.

Screw it down tightly with the four screws on the front.

Do not place any objects (e.g. this manual) on the cabinet of the solarinverter. Free ventilation behind the solar inverter must be able to take place unimpeded.

If the unit is installed in the open air, please take special care to ensure that the screwed cable glands are properly sealed and that the cabinet cover is precisely located.

Switching the solar inverter on and off

· Switching on
When the solar inverter is mechanically installed and connected to the electrical cables, the unit can be commissioned as follows:

Switch the grid connection on through the external safety cutouts.

Switch the PV generator voltage on by closing the PV generator switch. The solar inverter will start up with adequate PV power. If the PV input voltage is high enough, the solar inverter will begin operation and feed the solar energy into the electrical grid. You can see the operation on the display. The current feed-in power is shown here.

The solar inverter is supplied by the PV generator. The solar inverter switches on in the morning and off again in the evening. The relevant switching on and switching off thresholds are defined for the PV generator. If the solar energy is not sufficient to supply the electronics, several switch-on attempts may have to be made

in cloudy weather. This is normal, and does not affect either the yield or the mode of functioning of the solar inverter.

· **Switching off**
Disconnect the PV generator side first by opening the PV generator switch, and then the grid connection by isolating the relevant mains fuse.

If your PV system does not have a PV generator switch, you must disconnect the grid connection first of all by isolating the relevant mains fuse. When you do this, a "grid error" will be entered in the error memory of the solar inverter.

If the solar inverter is to be completely disconnected (e.g. removal) from the PV system, reconfigured or extended, the cabinet cover must be removed. Pay heed to all safety hints (Pages 90 and 91).

Open the main switch for the PV DC voltage and the mains fuse as described above. After a waiting period of at least five minutes, the solar inverter will be voltage-free.

Disconnection of the PV generator by removing the TYCO SOLARLOK connectors must never be performed under load. In the event of non-compliance, the connectors could be damaged by a strong electric arc. In this case, the relevant connectors must be replaced!

Remove the cabinet cover.

Check that the grid connection terminals are voltage-free.

Configurations

The solar inverter is basically configured with the Sunways NT Monitor program, using a laptop or PC (see enclosed CD).

In this regard please read the chapter «System Monitoring and Diagnosis» and «Sunways NT Monitor».

However, language setting, LCD contrast and total energy offset (only to be used in the event of replacement) must be configured directly on the unit. If you wish to configure the solar inverter without an external laptop or PC, or to change the language setting, please follow the instructions below:

Disconnect the solar inverter by isolating the mains fuse from the grid. The direct configuration of the solar inverter occurs with PV operating voltage present!

Please note that the unit is under DC voltage for configurations via the keys. Danger to life!

Please observe all essential regulations for «Working under voltage»!

This is the only exception for which work may be performed on the open unit under voltage!

Remove the cabinet cover to carry out the configuration.

The following settings can be performed using the illustrated keys:

· Address of the solar inverter: address «1» is stored in the memory at the factory. In the case of several solar inverters, consecutive numbering must be set. For three solar inverters e.g. the addresses «1», «2» and «3».
· Date
· Time
· Language (German or English)

PLUS   MINUS   ESC/CUR   UP/DWN   RST
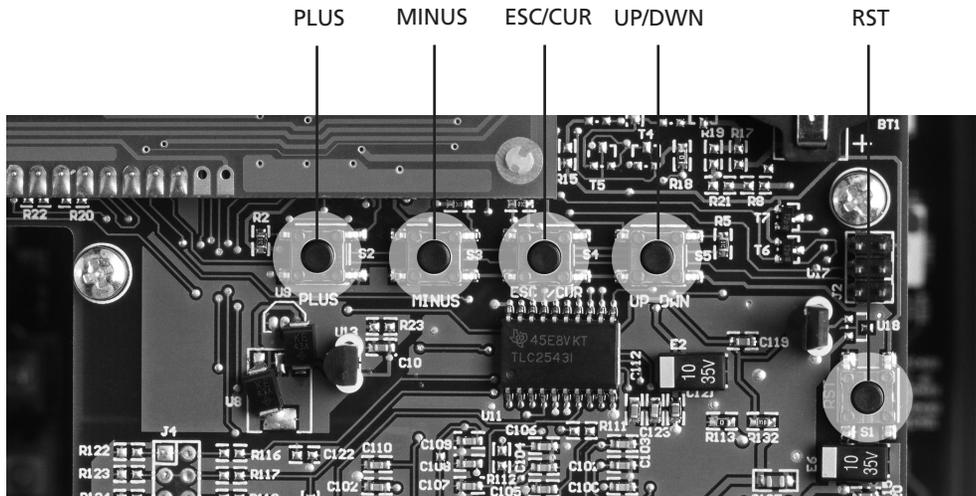
107   Fig.: The setting keys are located beneath the display.

Use insulating material to press the keys (e.g. a plastic rod). Avoid direct contact with the printed circuit board, so that the electronics cannot be damaged by electrostatic charging. The reset key (RST) only resets the data recording program to its original status. This does not affect the operation of the solar inverter.

Starting from the current display on the

Structure and menu levels for configuration
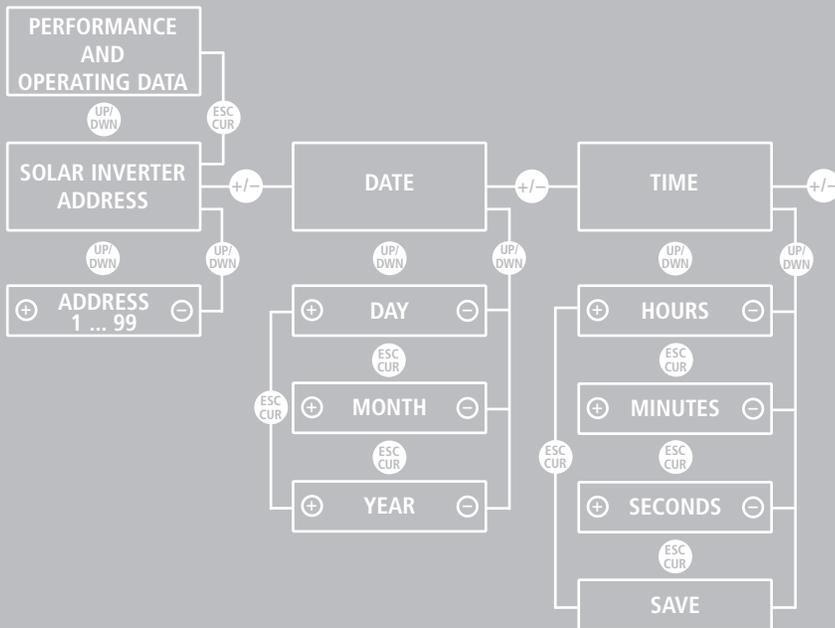
screen, you can reach the next menu level with the UP/DOWN key. The illustrated structure facilitates settings on the menu levels. Then save your settings by pressing the ESC/CUR key.

LANGUAGE	+/−	LCD CONTRAST	+/−	SOFTWARE VERSION	+/−	TOTAL POWER OFFSET

⊕ ENG./GER. ⊖

⊕ CONTRAST ⊖

⊕ kWh ⊖

INCREMENT (100 OR 1)

3.0 Information on operation
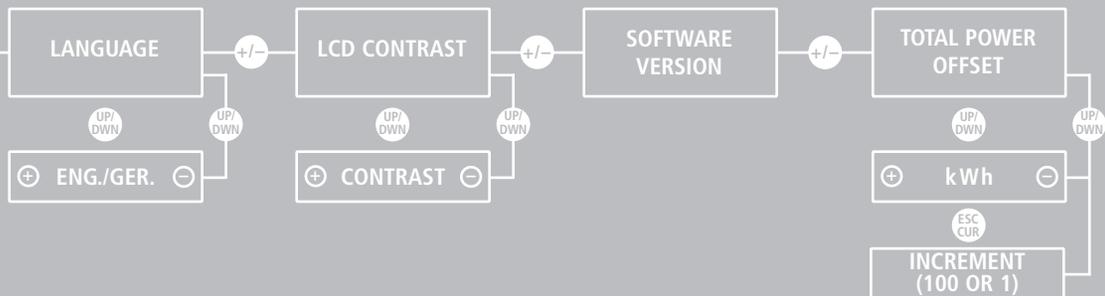
Display

The dot matrix LCD display is integrated into the cabinet of the solar inverter so that it is easily visible. The display consists of 16 characters and 2 lines. The top line 1 shows the current feed-in power of the solar inverter. The bottom line 2 outputs operating data. The data can be displayed in the German or English language.

Line 1	Current fed-in power	Power	kW
Line 2	AC voltage	U-AC	V
	DC voltage	U-DC	V
	Daily yield in Wh	W_TAG	Wh
	Total yield in kWh	W_GES	kWh
	Irradiation in W/m2 (*)	SOLAR	Wm2
	PV generator temperature in °C (*)	TEMP-PAN	C
	Time		

(* if the optional irradiation sensor with integrated temperature sensor is connected.)

Data memory

Your solar inverter is equipped with an internal data memory as standard. This data memory provides you with a detailed view of the mode of functioning and the relevant values of your solar power supply at all times. You can access these data with the help of the NT Monitor software described below. The following measured values can be determined:

· DC voltage
· AC voltage and AC current (power calculation)
· Irradiation and module temperature (if a sensor is connected)
· Time and date

The following values can be accumulated, stored and successively overwritten:

· 15 minute values for AC current, DC and AC voltages, irradiation and temperature

· 120 times storage of 15-minute average values in the recirculating storage; storage depth: three days on average, then overwriting of values

· Storage of accumulated daily work in Wh and of 40 daily values in the recirculating storage and successive overwriting of values
· Storage of accumulated monthly work in kWh and of 13 monthly values in the recirculating storage, then overwriting of values
· Storage of faults with max. ten values, then successive overwriting of values

Please note that all displayed performance data are displayed with a nominal measuring accuracy of maximum 5 %. The energy counter of your EVU should be used as absolute reference for the fed-in energy.

General information

The Sunways NT Monitor visualisation software was developed for PV system monitoring and configuration of the solar inverter using PC. It is contained on the enclosed CD and can also be downloaded free of charge on the Internet from www.sunways.de. System prerequisites are:

· Intel Pentium from 100 MHz or higher
· Microsoft Windows 95/98/2000/NT
· At least 6 MB free hard disk storage space
· At least 16 MB main memory
· VGA monitor with at least 800 x 600 (120 dpi) resolution

All measured values can be transferred to a PC and visualised with the Sunways NT Monitor software. Online, fault, minute, daily and monthly values are available.

For connecting to your PC, Sunways solar inverters in the NT series are equipped with the RS 232 and RS 485 interfaces as standard. In the case of larger distances between PV system and PC, the data can also be transferred via a modem. We recommend using two external analogue modems made by ACER. If other modems are used, the functional reliability cannot always be guaranteed.

The modem (remote modem) installed in the solar inverter must be initialised prior to installation with the help of the Sunways NT Monitor software. Note the "Help" function in the program in this regard.

The second modem (local modem) is connected to the RS 232 interface of your PC. This modem must not be initialised.

Different interface cables are required, depending on the type of connection. These are included in the accessories.

Up to 99 solar inverters can be monitored and read out by means of a connection via the RS 485 interface.

If the data are read out via the RS 485 interface and converted to RS 232 with an interface converter, we recommend the converter type «I-7520 Converter»

from ICP-Deutschland, (available from your specialist dealer), which will guarantee reliable data transfer.

The addresses of the solar inverter must be input in the solar inverter using the Sunways NT Monitor software or input directly with the keys illustrated on page 107.

Initialising the remote modem

If a remote modem is installed in the solar inverter, it must be initialised using a PC and the Sunways NT Monitor software.

· Connect the powered remote modem to the PC via the COM port. Use the interface cable provided with the modem for this purpose. Start the Sunways NT Monitor and set «Acer Modem» under the «Settings/Remote Modem» menu.

· Click «Perform initialisation» and wait until the scroll bar has come to an end. The modem can now be switched off and connected to the solar inverter via the RS 232 interface.

· Attention! Do not initialise the local modem!

· The remote modem is now initialised so that it automatically accepts a connection after two rings and connects at 9600 Baud.

Connection and circuitry options

| PV | — | INVERTER (1) | RS 232 | PC |

Connection to PC via RS 232	
Yellow Green Brown RS 485+ RS 485+ RS 485− RS 485− GND_G TX RX GND_G TX 2 RX 2	A single solar inverter can be directly connected to a PC via the RS 232 interface **Stripped length: 11 mm** **Jumper JP400: open**

(1) This connection can be used to read out an individual solar inverter if the distance from the PC used does not exceed 50 m. To do this, cable type A is stripped to 11 mm and connected to the solar inverter.

Connection to modem via RS 232	
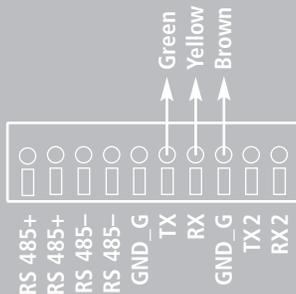
When connecting an individual solar inverter, the remote modem is connected directly to the RS 232 signal.

Stripped length: 11 mm
Jumper JP400: open
(see page 121)

(2) To install the remote inquiry of an individual solar inverter, the RS 232 signal can be routed directly from the solar inverter to the remote modem.
Cable type B is used for this purpose. For the RS 232 connection between solar inverter and modem, a cable length of 50 m should not be exceeded.

(3) PV system for 2 to 99 solar inverters with interface converter (IC)
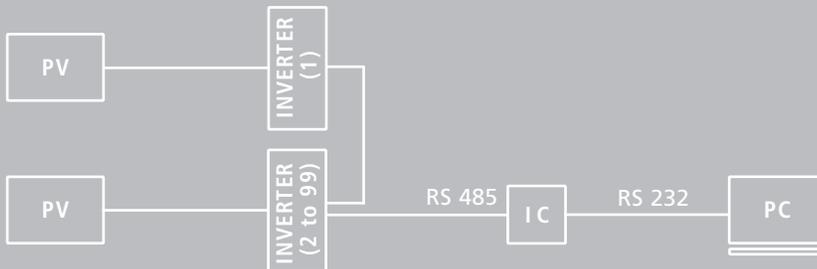
Connection to PC via RS 485/RS 232
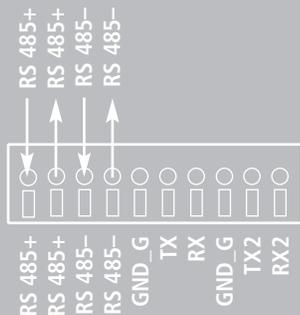
In order to connect several solar inverters to a PC, the RS 485 signal is looped through from inverter to inverter, until it is led into the interface converter. From here, the RS 232 signal is conducted to the PC. Jumper JP400 is connected to the solar inverter that is furthest away from the interface converter. It must be open for all other solar inverters.

Stripped length: 11 mm
Jumper JP400: see above

(3) Up to 99 solar inverters can be connected together and read out using this connection. In this case, there is a maximum cable length of 500 m between the interface converter and the furthest solar inverter. The individual solar inverters are connected together via the RS 485 interface.

The signal is looped through all units. Two «RS 485+» terminals and two «RS 485-» terminals are located on each terminal block. This means that the signal can be led into the solar inverter at one terminal and out of the solar inverter at the other terminal. The RS 485 signal is led out of the last solar inverter in the series into the interface converter using the following configuration: «RS 485+» to «DATA+» and «RS 485-» to «DATA-».

The interface converter generates an RS 232 signal. It is connected to the PC with the standard modem cable type D. Jumper JP400 must be closed at the solar inverter that is furthest away from the interface converter. For all other solar inverters it must be open. An address must be allocated, to enable identification of the individual solar inverters. This is described in Chapter 2.3 Commissioning, under «Configuration».

(4) PV system for 2 to 99 solar inverters with interface converter (IC) and modem for remote inquiry

| PV | INVERTER (1) | | | | | |
| PV | INVERTER (2 to 99) | RS 485 | IC | RS 232 | MODEM ···· MODEM | RS 232 | PC |

RS 485+
RS 485+
RS 485–
RS 485–
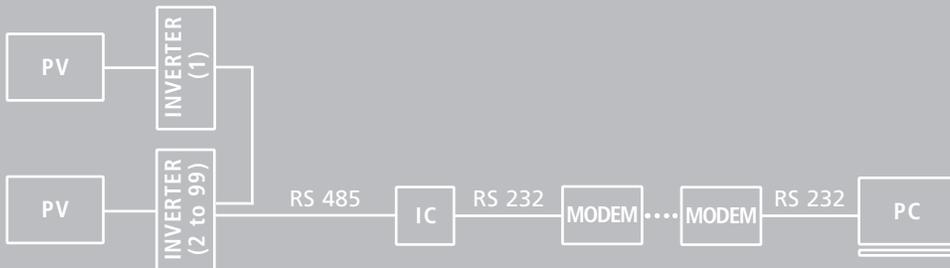
RS 485+
RS 485+
RS 485–
RS 485–
GND_G
TX
RX
GND_G
TX 2
RX 2
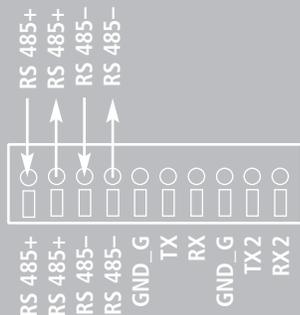
In order to connect several solar inverters to the remote monitoring, the interface converter is connected directly to a modem via RS 232. Jumper JP400 is connected to the solar inverter that is furthest away from the interface converter. It must be open for all other solar inverters.

Stripped length: 11 mm
Jumper JP400: see above

(4) If several solar inverters are to be connected to the remote inquiry, then the individual inverters are connected together by means of the RS 485 signal, as when reading out several units locally. This signal is converted by the interface converter into the RS 232 signal, from where it is led to the modem using cable type C. Jumper JP400 must be closed at the solar inverter that is furthest away from the interface converter. For all other solar inverters it must be open. An address must be allocated, to enable identification of the individual solar inverters. This is described in Chapter 2.3 Commissioning, under «Configuration».

Configuring the interface cables

Female connector to PC, 9-pole	6 7 8 9 — 1 2 3 4 5	TX RX GND

TX — Signal cables to the solar inverter on X400

RX

GND
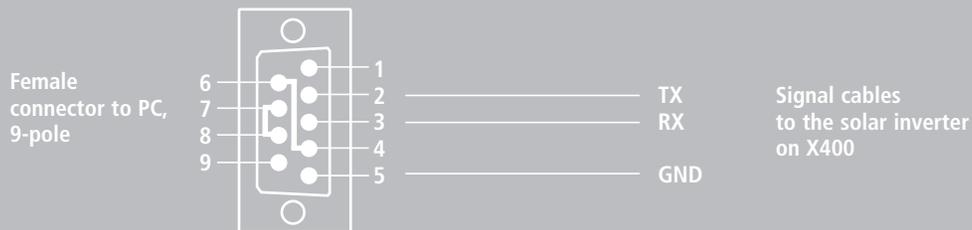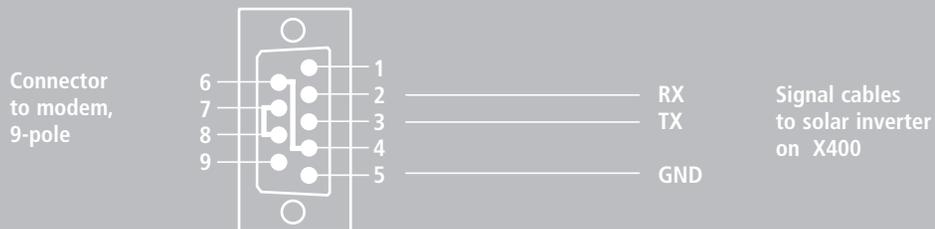
Connector to modem, 9-pole	6 7 8 9 — 1 2 3 4 5	RX TX GND

RX — Signal cables to solar inverter on X400

TX

GND

120
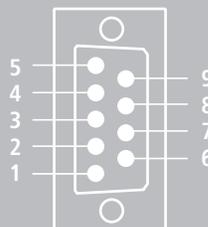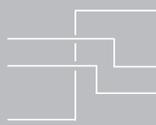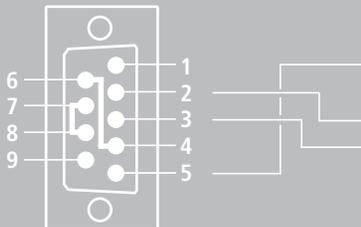
Locating jumper JP400 in the Sunways Solar Inverter

Please check the correct position of jumper JP400, depending on your selected communication circuit. You will find this jumper above the communication connections (see figure opposite).

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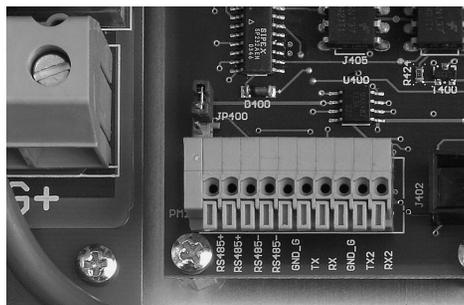
Sunways NT Monitor data acquisition

· Online values
DC voltage (U_DC), AC voltage (U_AC), AC current (I_AC), date, time, AC power, module temperature, module irradiation, «fed-in today», «fed-in since commissioning», error.

· 15 minute values
DC voltage (U_DC), AC voltage (U_AC), AC current (I_AC), date, time, temperature, irradiation, «fed-in in 15 minutes», accumulated daily total of all 15 minute average values.

Representation as graphic or print; Option of saving as bitmap; Fade-in of graphics possible. Individual solar inverters can be called up with the scroll menu.

· Daily values
Date and daily energy in the solar inverter.

Representation as graphic or print; Option of saving as bitmap; Zoom-in of graphics possible. Individual solar inverters can be called up with the scroll menu.

· Monthly values
Date in the solar inverter, fed-in since commissioning and monthly energy.

Representation as graphic or print; Option of saving as bitmap; Zoom-in of graphics possible. Individual solar inverters can be called up with the scroll menu.

· Fault data
Date, time and type of fault (for the last ten faults)

· Calendar
Date and time in the solar inverter

· Modem
Selection of the modem type and input of the address signal

If required, detailed information on Sunways NT Monitor can be found under the «Help» menu item in the program software.

Operation of Sunways NT Monitor

After installing the Sunways NT Monitor software on your PC, you can start the program. The word «Sunways» will now appear on your screen.

On the menu bar at the top, you will see the four menu areas «Program», «Data», «Settings» and «Help».

· **Setting menu**
To configure your solar inverter, open the «Settings» menu by clicking on it with the mouse, and click on the «Inverter» key. Enter the address number that you have defined for your solar inverter next to «Inverter». For example, the number «1» for one solar inverter. In the case of several units, select «all».

Then enter the desired date and time. The settings are transferred to the solar inverter by clicking on the «Make change» key.

If you are using several solar inverters and wish to make a change to the numbering, you can enter the old number of the

solar inverter in the top section of the right window half and the new number beneath it. The numbering is changed by clicking on the «Make change» key.

Exit the window with the «Close» key. You will go back to the «Setting» menu.

You can set the interface configuration with your PC by clicking on the «Connection» key.

By clicking on the «Remote modem» key, you can configure an optional modem (e. g. if you wish to retrieve data by remote inquiry).

· **Data menu**
In the «Data» menu, you can call up the current accumulated performance and energy of the solar inverter by clicking on the «Online» key.

You can display the data measured at 15 minute intervals by clicking on the «Minute values» key. The data and values are graphically visualised by clicking on the «Graphic representation» key.

You can call up «Daily values» and «Monthly values» in the same way, by clicking on the respective keys.

Exit the window with the «Close» key. You will return to the «Settings» menu.

· **Help menu**
You will find further helpful information on operating the Sunways NT Monitor software in the «Help» menu.

Your solar inverter operates fully automatically and maintenance-free. However, if operational faults occur due to external or internal causes, these will be displayed on the screen.

· **AC over/undervoltage (3-phase)**
Your solar inverter monitors the limits of minimum and maximum permissible 3-phase grid voltage. If these limits are exceeded (Umin = 184 V, UN = 230 V, Umax = 264 V), the solar inverter will switch off and will only start up again when the voltage value is within the limits. The fault cut-out can be triggered even by very brief overvoltages and undervoltages.

Display for AC overvoltage:

Line 1	Error: UAC_3

Line 2	Overvoltage

Display for AC undervoltage:

Line 1	Error: UAC_3

Line 2	Undervoltage

· **AC over/undervoltage (1-phase)**
Your solar inverter monitors the limits of minimum and maximum permissible grid voltage in the feed-in phase. If these limits are exceeded, the solar inverter will switch off and will only start up again when the voltage value is within the limits.

Display for AC overvoltage:

Line 1	Error: UAC_1

Line 2	Overvoltage

Display for AC undervoltage:

Line 1	Error: UAC_1

Line 2	Undervoltage

EN

· **DC overvoltage**
A maximum no-load voltage of 750 V is
permitted for the PV generator.
All components of the DC input are ade-
quately dimensioned with a safety factor.
If the threshold is exceeded, the solar
inverter stops the feed-in and a «DC over-
voltage error» is displayed.

Display for DC overvoltage:

Line 1	Error: UDC

Line 2	Overvoltage

· **AFI residual current**
The AFI residual current (insulation error,
ground fault) is displayed if a residual
current has occurred in the PV system and
the solar inverter has subsequently discon-
nected from the grid. Ground faults are
monitored on both the AC and DC side
(universal current-sensitive FI). If this error
message is displayed, the entire PV system
must be checked for insulation errors. The
AFI residual current operated device only
monitors the phase into which feed-in
occurs.

Display for AFI error protection:

Line 1	Error: AFI

Line 2	Residual current

· **Overheating fault**
Your solar inverter is designed for an
ambient temperature of up to +40°C.
When the maximum upper temperature
threshold is reached, the feed-in is stop-
ped. When the heat sink temperature
has decreased, the solar inverter starts
up again automatically.

Line 1	Error: TEMP

Line 2	Overtemperature

3.4 Fault diagnosis

Fault display	Causes	Remedies
Overtemperature	The maximum permissible ambient temperature of 40°C has been exceeded.	The installation location is not suitable. Please find another installation location.
	The necessary air circulation was not taken into account during installation.	Clean the solar inverter if dirt is impeding the cooling unit.
	Objects have been stored on the heat sink, impeding free convection.	Remove the objects.
UDC Overvoltage	The maximum DC voltage has been exceeded.	Check the dimensioning of your PV generator.
	Too many modules are connected in series.	Reduce the number of modules and re-commission the system.

Fault display	Causes	Remedies
UAC_1 UAC_3 AC under/over-voltage	The grid voltage is too low or too high.	The solar inverter monitors the limits of the minimum and maximum permissible 3-phase grid voltage. If the values exceed or fall below these limits (Umin = 184 V, Umax = 264 V), the solar inverter switches off and only restarts automatically when the voltage value has returned within the limits. The fault cut-out can be triggered even if the values only exceed or fall below the limits very briefly (up to ca. 1 ms). Ask your electricity board about grid stability and design.
	The cable cross-section in the AC feed line to the solar inverter is too small.	Check the format of your grid connection (energy counter) and the grid feed-in point to your electricity board.
	Your solar system feeds into a spur line, which is inadequately dimensioned.	

Fault display	Causes	Remedies
AFI Residual current	The AFI error is displayed if a residual current has occurred in the PV system and the solar inverter has subsequently disconnected from the grid.	The entire PV system must be checked for insulation errors.
Incorrect time, date are stored in Sunways NT Monitor with incorrect time data.	The battery is empty.	Have the battery (button cell) replaced by an expert. The battery is located on the LCD display board.

· **Warranty period**

The warranty period is five years from purchase of the solar inverter by the end user. Please complete the enclosed warranty card and return it to Sunways AG. Please keep the original invoice with the date of purchase in a safe place. This will be required as proof, in addition to the warranty card, in the event of a claim.

· **Conditions**

During the warranty period, the solar inverter will be repaired free of labour and material costs in Constance. Installation costs are borne by the customer, unless agreed otherwise. The completed warranty card must be sent to Sunways AG, Constance within seven days of purchase.

Please notify us of any warranty claims by telephone (technical hotline: +49 7531 99677577), stating your name, address, telephone and serial number, and your email address if applicable.

Sunways AG must be allowed the necessary time to eliminate the defect. Sunways AG will endeavour to eliminate the defect within 14 days of receipt of the unit. If this is not possible, the customer will be informed of the reason and the time when the defect will be eliminated will be specified.

Please preserve the original packing, even after expiry of the warranty period. Carriers may only accept solar inverters in transport-safe original packing. Therefore, please inform us before collection if you have lost the original packing. We will gladly provide you with new packing for a charge.

· Exclusion of liability

Warranty claims and liability are excluded for direct or indirect damages due to:

· Interventions, modifications or attempted repairs
· Inadequate ventilation
· Force majeure (e.g. lightning strike, water damage, vandalism, fire, overvoltage, thunderstorms etc.)
· Inappropriate transport
· Non-observance of pertinent regulations or incorrect installation or commissioning
· Leakage of overvoltages from the varistors on the DC side on the PV generator

More extensive or other claims for direct or indirect damages, particularly claims for damages, including those arising from positive contract violation, are excluded, unless legally prescribed.

4.0   Appendix

Designation	Description
AC	Alternating Current: grid current
AFI, RCD	Operator protection in the event of residual currents AFI: Universal Sensitive Residual Current RCD: Residual Current Device
DC	Direct Current PV generator side of the solar inverter
EMV	Electromagnetic Compatibility
EB	Electricity Board
I_{NDC}	Current used to operate the solar inverter
IP	Identification of class of protection against external environ-mental influences (penetration of water and mechanical foreign bodies)
kW	Kilowatt
LCD	Liquid Crystal Display
MPP	Maximum Power Point

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Designation	Description
Grid impedance	AC resistance of grid, impedance
P_{NDC} P_{NAC}	DC and AC rated power: Power which the inverters can permanently consume (DC) or emit (AC).
PT	Temperature sensor
PV	Photovoltaic
PV generator switch	DC load break switch to cut off the PV generator from the solar inverter
U_{NDC}	Voltage: specifies the normal operating voltage at which the solar inverter is operated

Functional principle and explanations

The electrical energy of the PV generator is buffered by a capacitive storage, from where it is fed into the public grid via a solar inverter synchronised with the grid, with an ideal phase angle of [cos phi = 1].

A sinusoidal current with a very low harmonic distortion is injected into the public grid by the current injection inductor. This improves the grid quality.

Thanks to the HERIC® technology (patent applied for) in the self-commutated Sunways Solar Inverter, the hysteresis losses in the current injection inductors that occur in conventional solar inverters and the switching losses in the semiconductors are considerably reduced. Consequently, Sunways Solar Inverters achieve a peak efficiency during conversion. The concept of the Sunways Solar Inverter is completed by a rapid MPP control, which maintains the MPP point with a very high adaptation efficiency.

· **DC and AC filters**
The DC and AC filters are specially designed EMC filters, which are integrated as direct components on the board. They guarantee compliance with the EMC limit values on the AC side and on the PV generator side. High-frequency emissions are avoided by the filters on the PV generator side.

· **Differential measurement**
The generator current and the voltage are recorded via a current transformer and a differential measurement. The values are important input values for the regulation and setting of the correct working point.

· **Solar inverter with HERIC® technology**
The heart of the solar inverter with the power semiconductors serves for conversion of the current from direct into alternating current. Peak efficiencies are achieved, thanks to the HERIC® technology. The switching frequency (PWM) is 16 kHz.

EN

· Grid protection
The grid protection is a powerful relay which ensures reliable grid disconnection in the case of error and for night switch-off. This relay fulfils the requirement for trouble-free grid disconnection.

· **Microcontroller**
As well as system management, the efficient microcontroller undertakes additional tasks, such as saving data and communication.

· **LCD display**
Important information for the operator about the system operation and status is displayed on an LCD display of 2 x 16 characters.

· **RS 485 and RS 232 interfaces**
The two RS 485 and RS 232 interfaces installed as standard serve for communication with the solar inverter and the PV system. The system can be visualised via the Sunways NT Monitor software.

· **Sensor interface**
An irradiation sensor with integrated temperature sensor can be optionally connected to the relevant interface. This allows first time users to quickly grasp the mode of functioning of their PV system, and facilitates monitoring of the PV system for professionals.

· **AFI universal sensitive residual current device**
The universal (DC and AC) sensitive residual current device (AFI) monitors the solar system for residual currents. To do this, it disconnects the solar inverter from the grid by means of a relay as soon as a residual current occurs on the PV generator side or on the AC side in the solar inverter. After cutoff by the relay and as soon as the residual current has stopped, the AFI automatically attempts to reconnect the solar inverter to the grid. The AFI of the Sunways solar inverter complies with standard DIN V VDE V 0126-1-1.

In addition, the AFI of Solar Inverters NT 2600, NT 4000 and NT 6000 has an absolutely time-independent effective value

cutoff threshold, which is dependent on the performance class. The NT 2600 model is switched off at an absolute residual current of 130 mA, the NT 4000 model at an absolute residual current of 200 mA and the NT 6000 model at an absolute residual current of 300 mA. The AFI triggers within < 0.2 seconds.

· **MPP control**

The solar inverter has a rapid MPP control, which maintains the MPP point with a very high adaptation efficiency. If surplus power is provided by the PV generator, the solar inverter limits this by shifting the working point of the characteristic curve of the PV generator, so as not to exceed the maximum permissible AC feed-in power in accordance with VDEW.

PV-GENERATOR

DC-FILTER

CAPACITIVE STORAGE

HERIC®

TEMP CONTROLLER

I_{DC}

DIFFERER. MEASUREMENT

U_{DC}

CONTROL
DATAPRO

RADIATION
AND
TEMPERATURE

IRRADIATION SENSOR AND
TEMPERATURE SENSOR
(OPT.)

R_T

DATA

RS 232
RS 485

MICRO-
CONTROLLER

| CURRENT IMPRESSION INDUCTOR | AC FILTER | GRID PROTECTION | AFI RESIDUAL CURRENT |

AND CESSING

AFI

I_{AC}

U_{AC}

DIFFERER. MEASUREMENT

LCD-DISPLAY (2 LINES)

KEYBOARD

GRID
L 1, L 2, L E
N, P E

Technical data	
Model	**Solar Inverter NT 2600**
Recommended PV generator power	1500 bis 2750 W
DC Rated input power	2300 W
Stand-by consumption	9 W
Night-time consumption	< 0.005 W
AC energy generated from	15 W
Nominal voltage	400 V
U_{MPP} voltage range	$350 \leq U_{MPP} \leq 650$ V
Open-circuit voltage	750 V
Switch-on voltage	410 V
Switch-off voltage	340 V
Maximum current	7 A
Nominal current	5.75 A
Number of inputs	2 (with adapter: 4)
Maximum efficiency	97 per cent
European efficiency (weighted)	96.5 per cent
HERIC® topology	yes
AC Rated continuous output power Pn	2200 W
Maximum power Pp	2200 W
Nominal frequency	50 Hz +/- 0.2
Grid voltage	230 V
Grid voltage tolerance range	- 20 to +15 per cent
Nominal current	9.6 A
Max. current	9.6 A
Distortion factor at Pn	< 3 per cent
Reactive power factor (cos phi)	~ 1
Output current	sinusoidal

Solar Inverter NT 4000	Solar Inverter NT 6000
2000 bis 4125 W	4000 bis 6250 W
3400 W	5200 W
9 W	9 W
< 0.005 W	< 0.005 W
15 W	15 W
400 V	400 V
$350 \leq U_{MPP} \leq 650$ V	$350 \leq U_{MPP} \leq 650$ V
750 V	750 V
410 V	410 V
340 V	340 V
10 A	15 A
8.5 A	13 A
2 (with adapter: 4)	2 (with adapter: 4)
97 per cent	97 per cent
96.4 per cent	96.3 per cent
yes	yes
3300 W	4600 W
3300 W	5000 W
50 Hz +/- 0.2	50 Hz +/- 0.2
230 V	230 V
- 20 to +15 per cent	- 20 to +15 per cent
14.3 A	20 A
14.3 A	21.7 A
< 3 per cent	< 3 per cent
~ 1	~ 1
sinusoidal	sinusoidal

Grid voltage monitoring	threephase
Earth fault protection	RCD (universally sensitive)
Output characteristic	current source
Grid connection fuse layout	16 A
Required number of grid connection phases	3
Number of feed-in phases (230 V single-phase)	1
Data interfaces	RS 232, RS 485
Sensor interfaces	irradiation, temperature
Display	LCD, 2 x 16 characters
System of protection against envir. influences	IP 54
Relative air humidity, max.	95 per cent
Cooling	free convection
Ambient temperature (Celsius)	- 25°C to 40°C
Dimensions (height x width x depth)	510 x 300 x 180 mm
Weight	26 kg
Noise development	silent (< 35 dB (A))
Standard warranty period (option)	5 years (10 years)

threephase	threephase
RCD (universally sensitive)	RCD (universally sensitive)
current source	current source
25 A	25 A
3	3
1	1

RS 232, RS 485	RS 232, RS 485
irradiation, temperature	irradiation, temperature
LCD, 2 x 16 characters	LCD, 2 x 16 characters

IP 54	IP 54
95 per cent	95 per cent
free convection	free convection
- 25°C to 40°C	- 25°C to 40°C
510 x 300 x 180 mm	510 x 300 x 180 mm
26 kg	26 kg
silent (< 35 dB (A))	silent (< 35 dB (A))
5 years (10 years)	5 years (10 years)

TYCO SOLARLOK connectors

⚠

**The TYCO SOLARLOK connectors
are only approved for connection to
permanently laid cables!**

**They must not be disconnected
under load!**

**The circuit must be interrupted at
a suitable point! The cables must be
provided with a suitable adhesive
label close to the TYCO SOLARLOK
connector!**

**The TYCO SOLARLOK connectors must
always be disconnected from other
voltage sources on all sides during
assembly, in order to protect against
electric shock.**

Fig.: Manual crimping tool for assembly of
TYCO SOLARLOK connectors

Any type of soiling (dust, humidity etc.) will negatively affect the operation of the system over the desired period of use. This applies particularly for the usability of the seals and crimping of the contacts. The utmost care must therefore be taken to work cleanly during installation.

Different circular contacts are used for different conductor cross-sections for the TYCO SOLARLOK connectors. The correct tool insert must be used, depending on this cross-section. The enclosed TYCO SOLARLOK connectors are equipped with circular contacts for a cable cross-section of 4 mm. The enclosed seals have internal dimensions of 6 (for cables of 5.3 to 6.2 mm sheath diameter) and 8 mm (for cables of 7.2 to 8.0 mm sheath diameter). The seal must be matched to the sheath diameter of the cables used.

The following sequence must be observed for assembly of TYCO SOLARLOK connectors:

1. Strip the voltage-free cable by 8 mm.
2. Crimp on the circular contact.
3. Push the cable gland, clamping piece and seal onto the cable.
4. Engage the contact in the connector housing.
5. Screw on the clamping nut.
6. Tightening torque of the threaded cable gland is 1.5 Nm.
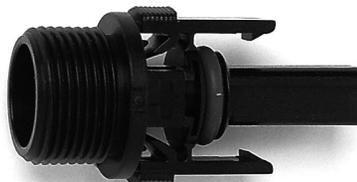
Declaration of Conformity as per EG Low Voltage Guidelines 73/23/EWG, attachment III B

We herewith declare that the following product including the required accessories has been manufactured according to the EG guidelines 73/23/EWG and 93/68/EWG:

Product		Solar Inverter
Manufacture		Sunways AG, Photovoltaic Technology
		Macairestr. 3 - 5, D - 78467 Konstanz
Type		Sunways NT 6000, NT 4000, NT 2600
From date of manufacture		2003-05-15
Applied standards	Standard	EN 50178
	Title	Electronic equipment for use in power installations
	Edition	1998

Explanation
This product is a component intended for further assembly. Due to the features resulting therefrom, the product cannot initially meet requirements made of finished products, machines or plants. It must thus be used for mounting / assembly only.
An evaluation of electrical and mechanical safety and of environmental conditions (e.g. extrinsic objects and / or humidity) must be performed after mounting / assembly in the finished plant.
The EMC characteristics of this product can change in a mounted / assembled state. An EMC check must thus be made for the PV-System by the manufacturer of the PV-System.

Konstanz, 2004-08-05

City, Date   Roland Burkhardt,CEO

Declaration of Conformity as defined by the EMC guideline 89/336/EWG with revisions 91/263/EWG and 93/68/EWG.

We herewith declare that the following product has been manufactured according to the requirements outlined in the EG requirements on 89/336/EWG (EMC guideline with revisions 91/263/EWG)

Product		Solar Inverter
Manufacturer		Sunways AG, Photovoltaic Technology
		Macairestr. 3 - 5, D - 78467 Konstanz
Type		Sunways NT 6000, NT 4000, NT 2600
from date of manufacture		2003-05-15
applied standards	Standard	EN 50082-2 (EN 61000-4-2, -4-3, -4-4, -4-6, -4-8)
		EN 55014-1; EN 55011; EN 61000-3-2;
		EN 61000-3-3; E DIN VDE 0126

Explanation
Maintaining the EMC guideline assumes an EMC adapted installation of the component within the plant or the machine. Please pay attention to the installation notes of the technical specifications. Tests were carried out using a typical construction in a test assembly that conforms with the stands. The legal requirements with regard to resistance to interference and to emission of interference, limit values and standards are outlined in the above mentioned documentation.
These Sunways products are intended for installation into a PV-System. The test results are not applicable to every installed state in every PV-System. This declaration therefore does not guarantee the EMC characteristics of the end product.

Konstanz, 2004-08-05

City, Date   Roland Burkhardt, CEO

**Declaration of Conformity of
nominal power and maximum output power
of solar inverters.**

Product	Solar Inverter		
Manufacturer	Sunways AG, Photovoltaic Technology		
	Macairestr. 3-5, D-78467 Konstanz		
Type Sunways	NT 6000	NT 4000	NT 2600
Nominal power S_N	4,6 kVA	3,3 kVA	2,2 kVA
Maximum output power $S_{max10Min}$	5 kVA	3,3 kVA	2,2 kVA
$S_{max10Min}/S_N$	1,08	1	1

Explanation
The maximum output power of the solar inverter has to be declarated as a max. 10 minute average.

Konstanz, 2004-08-05

Ort, Datum   Roland Burkhardt, CEO

Declaration of Conformity as defined by the guidelines for connection and grid feeding in parallel of in-plant generation on low-voltage-guidelines (VDEW 4. Edition 2001).

We herewith declare that the following product has been manufactured according to the requirements outlined in the guidelines for connection and grid feeding in parallel of in-plant generation on low-voltage-guidelines:

Product		Solar Inverter
Manufacturer		Sunways AG, Photovoltaic Technology
		Macairestr. 3-5, D-78467 Konstanz
Type		Sunways NT 6000, NT 4000, NT 2600
From date of manufacture		2003-05-15
Applied standard	Standard	
	Title	In-plant generation on low-voltage-guidelines
	Edition	4. Edition 2001

Explanation
The NT series of solar inverters from Sunways are monophase inverters that are not capable of isolated operation. They are equipped with a voltage monitor and three phase monitoring of the line voltage for undervoltage in accordance with section 2.4.2 of the VDEW Guideline (4th edition 2001). A constantly accessible isolation point is therefore not required (see section 2.1.2 Switching point with isolating function). Observation of the cut-off values of the threephase undervoltage protection is undertaken by means of a routine check test on each device

Konstanz, 2004-08-05

City, Date   Roland Burkhardt, CEO

General exclusion of liability

Although the accuracy and completeness of the information contained in these instructions have been checked with the utmost care, no liability can be accepted for errors or omissions.

· Sunways AG reserves the right to modify the hardware and software features described here at any time, without prior notice.
· These instructions may not be duplicated, passed on, copied or translated in to other languages, either in whole or in part, in any form or by any means, without prior written permission of Sunways AG.
· Sunways AG does not provide any warranty for damages due to defective or lost data, incorrect operation or malfunctioning of the solar inverter, the software, additional equipment or PCs.

Registered trademarks

Sunways NT 2600, NT 4000 and NT 6000 and the Sunways logo are registered trademarks of Sunways AG, Constance.

HERIC® is a registered trademark of Fraunhofer, Munich.

sunways
Photovoltaic Technology